Wood Preservative Residues in Soil Roblin Forest Products, 1983

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Roblin Forest Products, 1983

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ABSTRACT

A study was undertaken to determine the degree and extent of wood preservative contamination (copper, chromium and arsenic) from the wood treatment operation.

A total of 66 surface and subsurface soil samples were collected on the Roblin Forest Products property. Eight soil samples were also collected at the former wood treatment facility which was abandoned in 1964. Soil samples were analyzed for copper, chromium and arsenic.

Background concentrations of copper, chromium and arsenic in surface soils for Roblin are: 25 µg/g; 40 µg/g and; 27 µg/g respectively.

Results of this study indicate ranges of contaminants in surface soil from 25 to 2400 µg/g for copper, 60 to 2200 µg/g for chromium, and 27 to 6500 µg/g for arsenic.

Concentrations were highest in the surface (0-5 cm) soil layer, in the vicinity of the wood treatment plant and treated wood storage area. Concentrations decreased as the distance from these areas increased. There was evidence of contamination in the subsurface layers (5-12 cm).

Contaminant dispersion within the property limits results from vehicle activity, wind, ground levelling and runoff. Distribution patterns varied with direction. Elevated levels occurred as far as 340 metres east of the treatment plant.

Elevated concentrations were found at the former site but levels were lower compared to present site. Highest contaminant levels were confined to the surface (0-5 cm) soil layers.

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Roblin Forest Products Soil Survey, 1983

1. INTRODUCTION

In August 1982, Terrestrial Standards and Studies conducted a preliminary soil sampling survey on the Roblin Forest Products property to evaluate potential soil contamination caused by fugitive wood preservative. Results of that preliminary survey were reported previously (McEachern and Phillips 1983). Results revealed significantly elevated levels of copper (Cu), chromium (Cr) and arsenic (As) in surface soil sampled next to the wood treatment cylinders and in areas where freshly treated wood was stored for drying. Concentrations of these chemicals decreased to background beyond those areas. With time, the contaminant dries to a powder that can be transported to adjacent areas by wind dispersion. The dust may pose a potential health hazard to on-site workers and town residents who live in close proximity to the plant operation.

To document the degree and extent of Cu/Cr/As contamination throughout the Roblin Forest Products property, Terrestrial Standards and Studies conducted a more extensive soil sampling program in the summer of 1983. In addition, a second objective was to identify the precise location of the former wood treatment site, and conduct a small scale soil study, to determine whether there were residues of chemical preservative at the former plant site.

2. METHODS

2.1 Sampling Procedures

On June 7, 8 and 9, 1983, soil sampling surveys were carried out at both the former and existing plant sites. At the present site 33 soil sample points were identified along 8 transect lines (Figure 1). This sample design provided respresentative coverage of the Roblin Forest Products grounds. At each location a surface (0-5 cm) and subsurface (5-12 cm) soil sample was taken. At the former site, surface and subsurface soil samples were taken from four sample locations. All soil samples were processed and analyzed for copper, chromium and arsenic at the W. M. Ward Technical Services Laboratory.

3. RESULTS AND DISCUSSION

Soil analytical results are shown in Appendix 1 and summarized in Table 1. Figures 2, 3 and 4 illustrate the on-site distribution (isopleths) of copper, chromium and arsenic.

These data reconfirmed the trends that were observed in the 1982 soil study. Significant accumulations of Cu, Cr and As were found in the surface soil (0-5 cm) in areas close to the treatment plant and where freshly treated wood was being stored. Subsurface soil (5-12 cm) concentrations were lower, but still exceeded background values which indicates that active movement of the chemicals by leaching may be occurring.

Copper concentrations in surface soil at sites located on transect "A" ranged between 70 and 2000 µg/g respectively, while subsurface soil concentrations ranged from 23 to 330 µg/g. Chemical

concentrations decreased with increasing distance from the treatment area. The copper concentration at site B, 25 metres from the treatment building was 1900 µg/g while at a distance of 135 metres the copper concentration was 35 µg/g.

Sites C3, D3 and E3 appear to be beyond the contaminated area of the property and therefore may be considered representative of background levels in the soil. Of these, site C3 had the lowest concentrations in the surface soils: 25 µg/g copper, 40 µg/g chromium and 27 µg/g arsenic. Subsurface concentrations were comparable at 22, 28 and 36 µg/g for copper, chromium and arsenic respectively.

Phytotoxicologically excessive levels of the primary preservative ingredients in Canadian soils are: 100 µg/g for copper, 75 µg/g for chromium and 25 µg/g for arsenic (Ontario MOE 1978). Soils in the Roblin area have lower background concentrations of copper and chromium with only slightly elevated arsenic levels. Concentrations found in this study (Appendix 1) exceeded the Canadian excessive levels at 74% of sites for copper, 85% of sites for chromium and 100% of sites for arsenic. Subsurface soil concentrations were not as high, but still exceeded the "limits" at 52% of sites for copper, 67% of sites for chromium and 85% of sites for arsenic.

Figures 2, 3 and 4 illustrate contaminant residue distribution (isopleths) within the study area. The highest concentrations of copper and chromium occurred to a distance of approximately 70 metres east of the treatment building, whereas arsenic concentrations were highest to a distance of 30 metres west of the treatment building. Soil contamination by the wood preservative

was most extensive to the east, where concentrations exceeded background to 340 metres from the treatment plant. Contaminant distribution patterns for all three elements were similar in the north, west and south directions from the treatment plant.

Analytical results from the 1982 and 1983 studies have shown that the highest contaminant levels occur at the surface (0-5 cm soil layer) in areas where the wood treatment process and air drying stages take place. Once the chemical has dripped onto the soil, it can be transported to other areas of the property in several ways. Initially the liquid phase of the contaminant can be picked up by truck or tractor tires when moving freshly treated wood to the storage areas. A second means of transport occurs, when the spilled chemical dries and can be dispersed by wind throughout the property. This means of transport could cause a progressive increase in the contaminated area. A third means of transport could result from yard levelling, where the contaminant in either wet or dry form can be transported to other areas of the property by front end loader or grader. Extensive levelling over time could be the reason that contaminant levels are elevated in the subsurface (5-12 cm) soil. Contaminants could also be transported by runoff.

Drainage away from the treatment building and the area where treated wood is stockpiled is toward the southeast, generally following transect A. Drainage from the site would likely be intercepted by the north ditch along Annie Road and would flow through the culvert at G1 and from there in the general direction of A4 and finally to the depression at AA1. Although elevated concentrations at G1 indicate that runoff has carried wood preservative chemicals along

the ditch, the levels at A4 are only slightly elevated at the surface which means that only minor amounts of contaminant have reached that area. It is also possible that the contaminants found at the surface at A4 could have been moved there by yard grading or deposition of wind eroded dust. The general conclusion, based on these data, is that runoff water is not playing a major role in the redistribution of contaminants on the Roblin Forest Products property.

In summary, copper-chrome-arsenate wood preservative has contaminated the surface soils of a localized area of the Roblin Forest Products property. Concentrations of the primary preservative ingredients are elevated well beyond environmentally acceptable levels. Fortunately, it appears that they have not been dispersed off the property. Nevertheless, if state-of-the-art containment practices are not implemented, concentrations will continue to increase, the adsorption capacity of the soils may be exceeded and downward movement, presumably toward the groundwater, may occur. Present concentrations in the surface soils may pose a risk to on-site workers if and when yard dust is reentrained in the air.

At the original treatment plant location, 2nd Avenue NW, Roblin, 4 sites were set up at 10 metre intervals along a transect extending south and north of the weigh scale. The Cu, Cr and As concentrations found in soil samples, were lower than at the present site. However, concentrations were elevated compared with background indicating residual contamination. For example, copper concentrations at sites 1 and 2, the closest sites to the scales were 320 and 200 µg/g respectively. Copper concentrations at sites 3 and 4, the farthest sites away from the scales were 25 and 50 µg/g. Similar

concentrations of copper and chromium (Table 1) were found in both surface and subsurface soil samples. Copper ranged from 25 to 320 µg/g in surface soils, and 25 to 230 µg/g in the subsurface layer. Chromium levels ranged between 30 to 310 µg/g at the surface and 30 and 230 µg/g in subsurface layers. Arsenic concentrations ranged between 14 and 600 µg/g in surface layer and 12 to 400 µg/g in subsurface soil layer.

Although concentrations are higher than the phytotoxicologically excessive levels for Canadian soils (Ontario MOE 1978) the copper, chromium and arsenic are probably bound tightly to soil colloids, thus precluding any risk of their movement either vertically into the groundwater or laterally to adjacent properties. Furthermore, a normal cover of grass has been established on the site and no phytotoxic effects are evident in the vegetation growth. The fact that a well established cover of grass is present on the site also precludes the possibility of reentrainment of contaminated dust from the site into the air. Thus, it is believed that the accumulated levels of copper, chromium and arsenic at the former treatment site do not pose an enviromental hazard.

4. CONCLUSIONS

Accumulations of Cu, Cr and As were found close to the treatment building and in the area where the treated wood is stored. The highest concentrations occurred in the surface soil (0-5 cm) layer.

Some subsurface soil (5-12 cm) contamination has occurred but not to the same extent as surface soil contamination.

Concentrations in the surface soil exceeded phytotoxicologically excessive levels for Canadian soils at 73% of sites for Cu, 85% of sites for Cr, and 100% of sites for As.

Distribution patterns represented by isopleths of equal concentration, are similar for copper, chromium and arsenic over the study area.

Contaminant dispersion to adjacent areas can be attributed to transport by vehicle tires, wind and ground levelling.

Inhalation of reentrained soil dust by workers could pose a potential health hazard. There is also concern that if state-of-the-art containment practices are not implemented, the adsorption capacity of the soil may be exceeded, allowing the contaminants to move downward, presumably toward the water table.

Concentrations at the former site were elevated but lower than concentrations found at the present site. It is beleived that this contamination does not constitute an environmental hazard.

REFERENCES

McEachern, D. B. and S. F. Phillips. 1983. Status Report. Roblin Forest Products Ltd. Soils and Water Survey. Environmental Management Services Branch. 83-4. 14 pp.

Ontario Ministry of Environment. 1978. Phytotoxicology excessive levels for contaminants in soil and vegetation. Memorandum from S. M. Linzon, (Supervisor Phytotoxicology Section, Air Resources Branch) to regional managers.

TABLE 1: CONCENTRATION RANGES (μg/g) FOR COPPER, CHROMIUM AND ARSENIC AT ROBLIN FOREST PRODUCTS SITE, 1983.

TRANSECT LINE	COPPER		CHROMIUM		ARSENIC	
	SURFACE	SUBSURFACE	SURFACE	SUBSURFACE	SURFACE	SUBSURFACE
A	70.-2000.	23.-330.	90.-1700.	25.-100.	67.-1480.	13.-530.
B	35.-1900.	13.-300.	50.-2200.	25.-580.	42.-2000.	9.-460.
C	25.-2400.	22.-610.	40.-1900.	28.-370.	27.-6500.	36.-890.
D	58.-900.	24.-450.	80.-970.	30.-360.	76.-1600.	57.-875.
E	58.-600.	50.-350.	60.-670.	60.-370.	59.-960.	57.-495.
F	180.-1300.	20.-1100.	180.-1300.	80.-1100.	170.-1700.	25.-1500.
G	85.-830.	34.-280.	70.-880.	55.-470.	86.-1360.	37.-525.
H	45.-65.	26.	60.-90.	30.-35.	57.-94.	17.-36.
ORIGINAL SITE	25.-320.	25.-230.	30.-310.	30.-230.	14.-600.	12.-400.

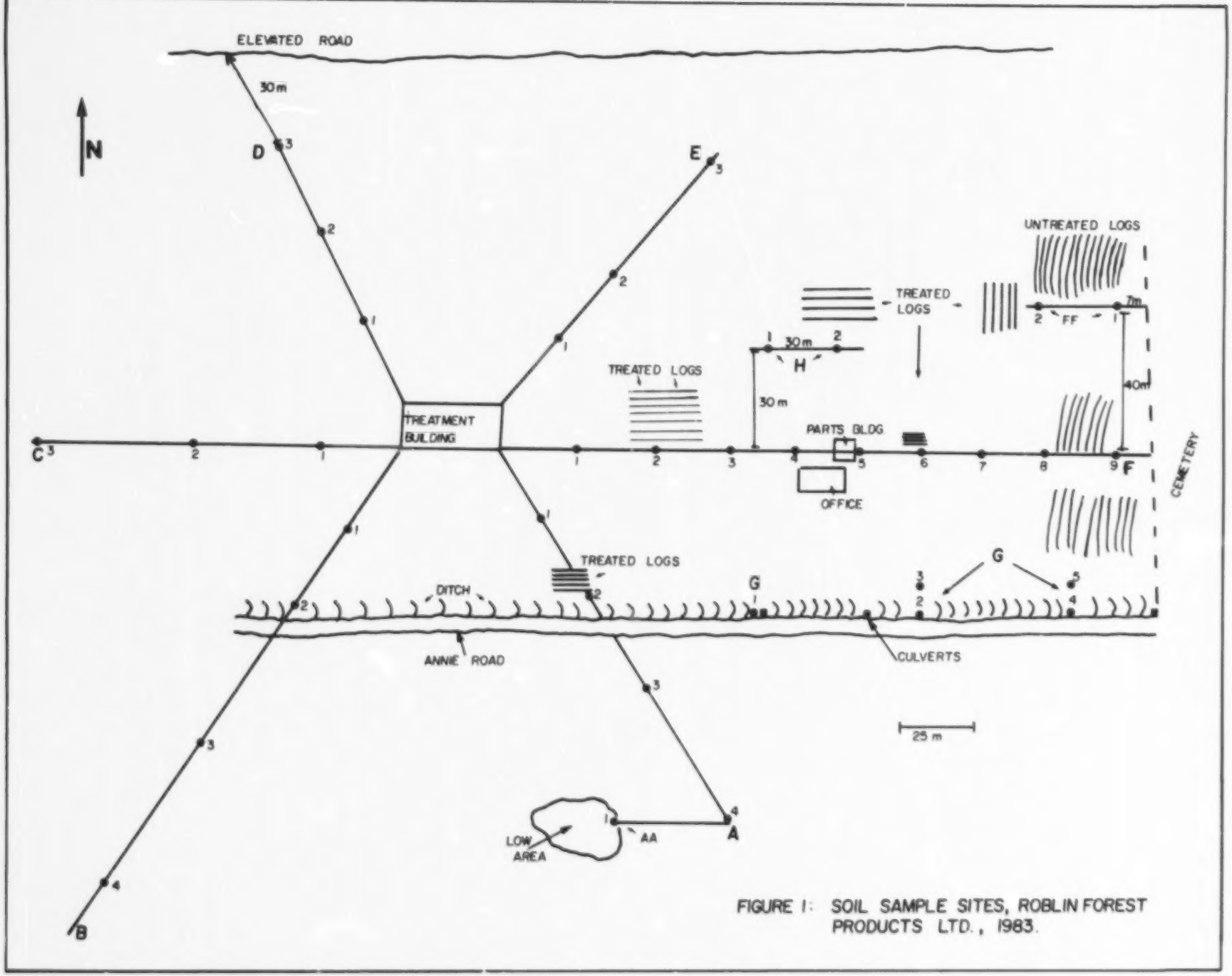

FIGURE 1: SOIL SAMPLE SITES, ROBLIN FOREST PRODUCTS LTD., 1983.

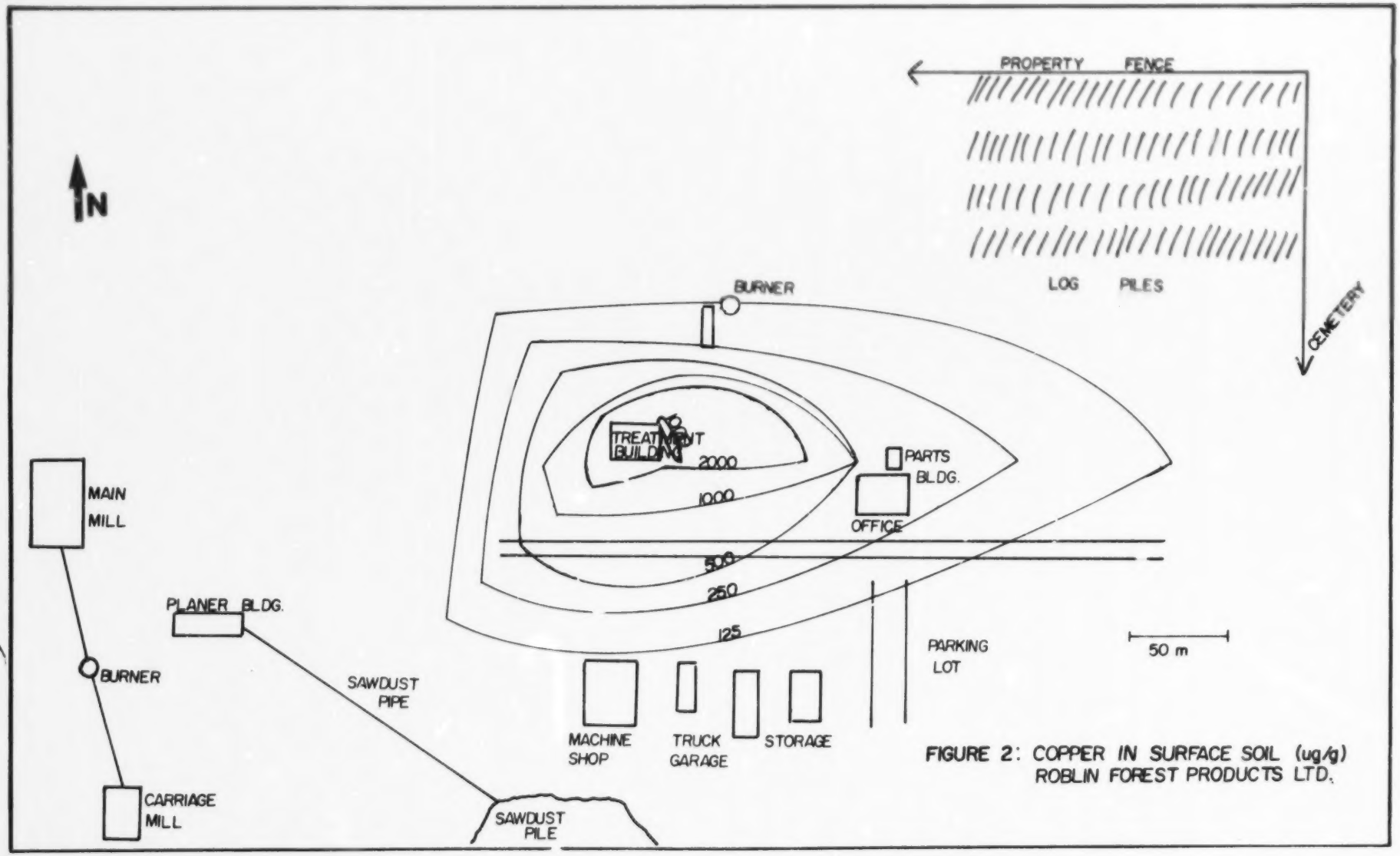

FIGURE 2: COPPER IN SURFACE SOIL (ug/g)
ROBLIN FOREST PRODUCTS LTD.

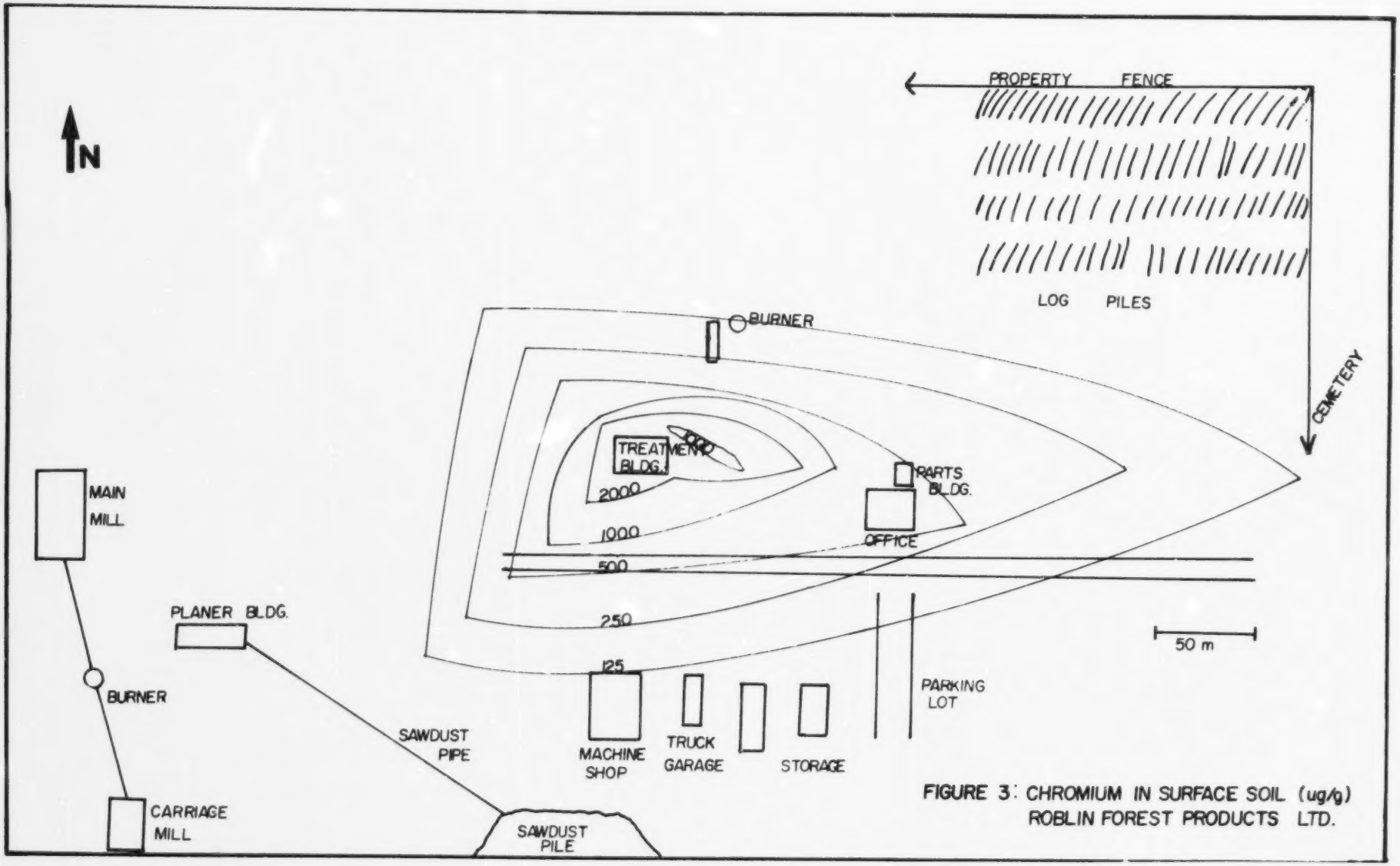

FIGURE 3: CHROMIUM IN SURFACE SOIL (ug/g)
ROBLIN FOREST PRODUCTS LTD.

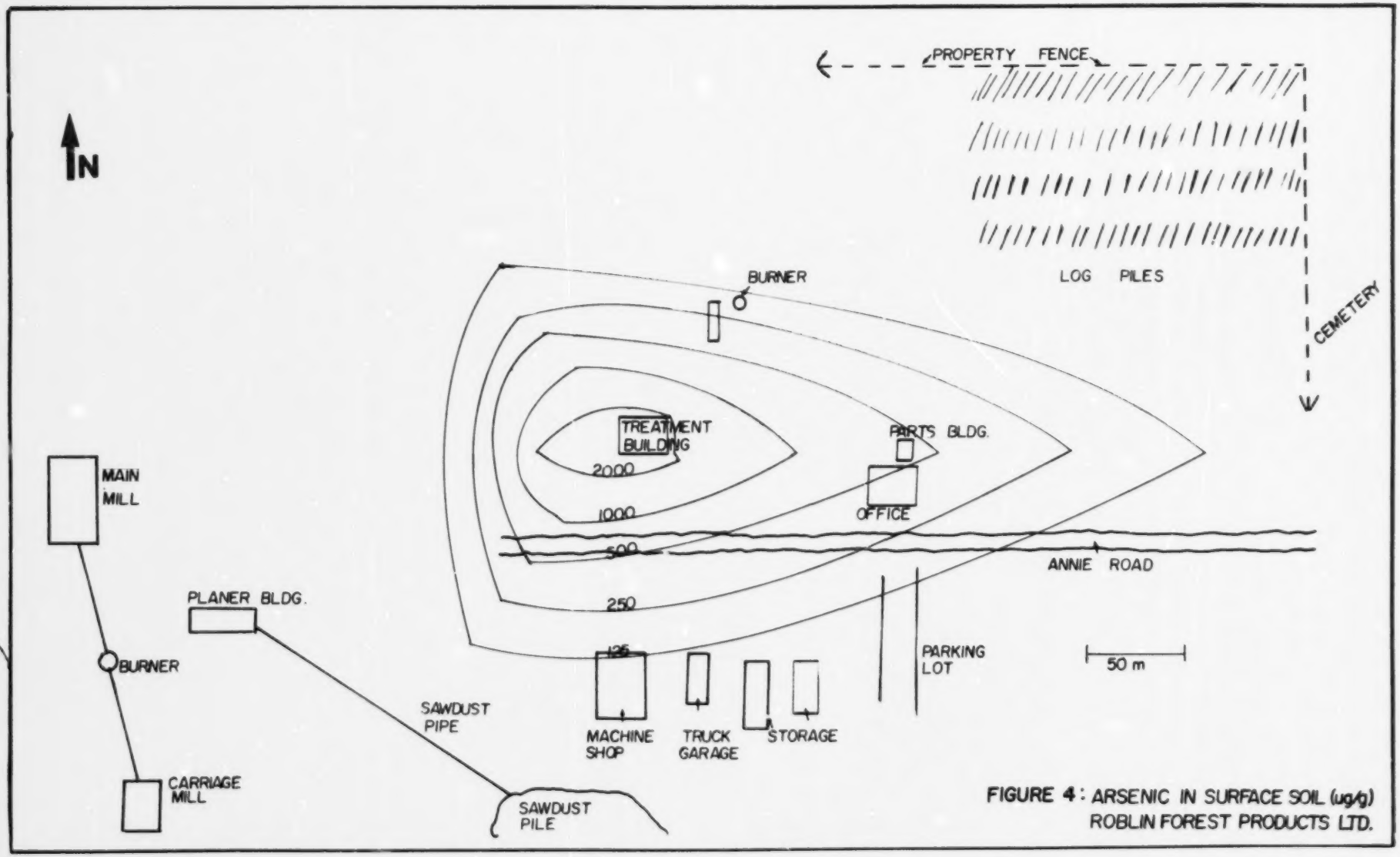

FIGURE 4: ARSENIC IN SURFACE SOIL (ug/g)
ROBLIN FOREST PRODUCTS LTD.

APPENDIX 1

APPENDIX 1: SOIL CONCENTRATIONS IN µg/g, ROBLIN FOREST PRODUCTS, 1983.

	COPPER		CHROMIUM		ARSENIC	
PARAMETER	SURFACE	SUBSURFACE	SURFACE	SUBSURFACE	SURFACE	SUBSURFACE
A_1	640	50	820	100	830	75
A_2	2000	330	1700	32	1480	530
A_3	170	120	160	95	230	130
A_4	70	23	90	25	67	13
AA_1	64	20	160	30	93	19
B_1	1900	280	2200	580	2000	360
B_2	600	300	790	420	740	460
B_3	110	13	240	25	140	9
B_4	35	32	50	70	42	57
C_1	2400	610	1900	370	6500	890
C_2	150	27	200	60	910	40
C_3	25	22	40	28	27	36
D_1	900	450	970	360	1600	875
D_2	240	94	260	95	430	130
D_3	58	24	80	30	76	57
E_1	600	350	670	370	960	495
E_2	220	110	240	110	340	185
E_3	58	50	60	60	59	57
F_1	900	410	1100	400	1400	595
F_2	520	400	640	480	850	530
F_3	1300	1100	1300	1100	1700	1500
F_4	610	560	920	750	1000	1080
F_5	180	180	180	160	280	190
F_6	220	20	780	210	320	25
F_7	310	200	350	280	570	440
F_8	250	68	380	80	290	86
F_9	190	350	230	410	170	310
FF_1	400	150	600	250	380	120
FF_2	270	360	380	590	230	250
G_1	180	280	230	470	350	525
G_2	130	120	250	150	130	200
G_3	830	95	880	320	1360	265
G_4	85	45	70	90	86	54
G_5	100	34	120	55	120	37
H_1	45	26	60	30	57	17
H_2	65	26	90	35	94	36
OS_1	320	230	310	230	600	400
OS_2	200	130	190	150	360	370
OS_3	25	25	30	30	14	12
OS4	50	34	50	88	42	17

SURFACE - 0-5 cm
SUBSURFACE - 5-12 cm